NASA SBIR/STTR Technologies

H2.02-8782 - Fine Grained Tungsten Claddings for Cermet Based NTP Systems

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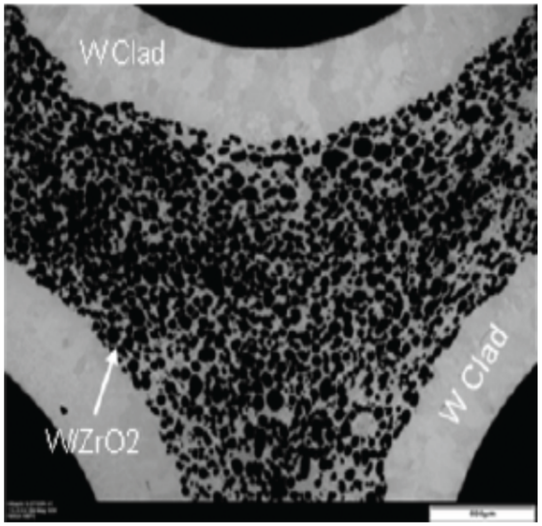
Identification and Significance of Innovation

A critical aspect of the Nuclear Cryogenic Propulsion Stage (NCPS) program is to develop a robust, stable nuclear fuel. One of the nuclear fuel configurations currently being evaluated is a cermet-based material comprised of uranium dioxide particles encased in a tungsten matrix. To reduce the potential for uranium hydride formation that can lead to grain boundary separation and cracking, the diffusion of hydrogen into the cermet must be minimized. Therefore, fine-grained tungsten claddings are needed. Recently, advanced electrochemical processing techniques (EL-Form?) have been developed that enable the tailoring of refractory metal microstructures through process parameter manipulation and/or alloy additions. Therefore, these innovative electrochemical forming techniques will be used to produce fine-grained, hermetic tungsten claddings for both the internal and external surfaces of cermet based nuclear fuel elements.

Estimated TRL at beginning and end of contract: (Begin: 2 End: 3)



Technical Objectives and Work Plan

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-Develop EL-Form? processing parameters to produce fine-grained tungsten claddings for cermet based nuclear fuel elements.

-Evaluate the direct deposition of W claddings on fuel elements and the use of preformed W deposits on sacrificial molybdenum mandrels.

-Characterize the effects of the different processing parameters on the microstructures of the EL-Form? W claddings.

-Determine the effects grain size, wall thickness, and coating method have on hermeticity.

-Measure the bond strength of EL-Form? tungsten coatings on preformed tungsten substrates.

-Perform high temperature furnace runs and thermal cycle tests using an Ar-H2 plasma torch to characterize cladding robustness.

-Using the most promising techniques, demonstrate the complete EL-Form? W encapsulation of a simulated cermet fuel element.

NASA Applications

NASA applications benefiting from this technology include Nuclear Thermal Propulsion (NTP) and Nuclear Electric Propulsion (NEP). The proposed Phase I and Phase II efforts would greatly assist NASA with achieving the goals of the NCPS project. Potential NASA missions include rapid robotic exploration missions throughout the solar system and piloted missions to Mars and other destinations such as near earth asteroids.

Non-NASA Applications

Commercial sectors that will benefit from this technology include medical, power generation, electronics, defense, aerospace, chemicals, and corrosion protection. Specific applications include protective coatings for gamma detectors, x-ray targets, valves, non-eroding throats and thrusters for propulsion, crucible/furnace components, and electrochromic glass.

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